MULTIMEDIA UNIVERSITY

STUDENT ID NO

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# MULTIMEDIA UNIVERSITY

# FINAL EXAMINATION

**TRIMESTER 3, 2022/2023**

## PIP 0255 - INTRODUCTION TO PHYSICS

( Foundation in IT Students only )

6 OCTOBER 2023
9.00 a.m. – 11.00 a.m.
(2 hours)

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**INSTRUCTIONS TO STUDENTS**

1. This Question paper consists of **5** pages only (excluding cover page and appendices page) with **5** Questions only.

2. Answer **ALL FIVE** structured questions. All questions carry equal marks and the distribution of the marks for each question/section is given.

3. Please print all your answers in the Answer Booklet provided.

**STRUCTURED QUESTIONS [5 questions × 10 MARKS = 50 MARKS in TOTAL]**

**Instruction:** Answer **ALL FIVE** questions. *Provide calculation steps whenever possible.*

**Question 1 (10 marks)**

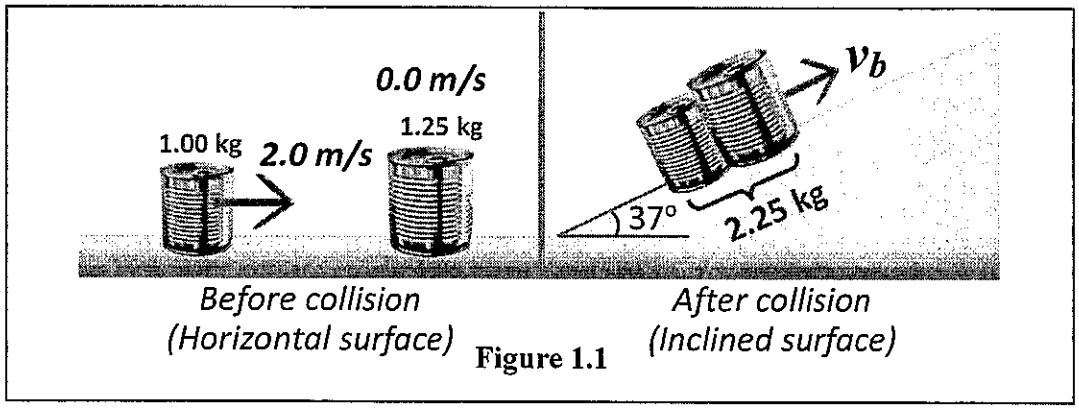


**Figure 1.1**

(a) **Figure 1.1**: In a food factory, tins can slide on a horizontal surface which then leads to an inclined surface (**37°** above the horizontal). A **1.00 kg** tin sliding at **2.0 m/s** collides with a **1.25 kg** tin (at **rest**) on the horizontal surface. As this is a *prefectly inelastic* collison, the two tins move up the inclined surface together (total mass of **2.25 kg**). *Ignore friction* (all surfaces) and take $g = 9.8$ m/s$^2$. Based on this, answer the following:

(i) What is the *velocity* of the two tins (together), $v_b$, after the collision? **(2 marks)**

(ii) What is the highest *distance* up the inclined surface (not vertical height) that the two tins will cover if the *conservation of energy principle* is applied? **(3 marks)**

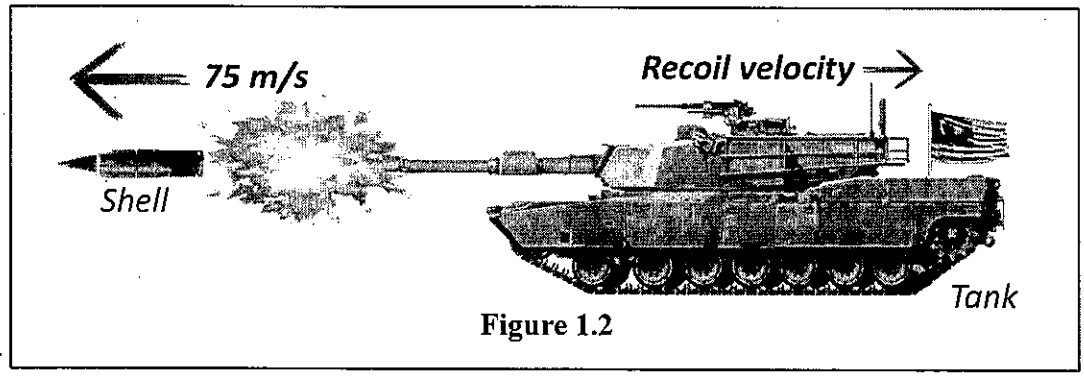


**Figure 1.2**

(b) **Figure 1.2**: A tank of **2800 kg** carries 10 (ten) tank shells with a mass of **25 kg each**. The total mass of the tank with the 10 tank shells is 2800 kg + (10 × 25 kg) = **3050 kg**. It is determined that every tank shell that is fired from the tank, will blast forward with a *velocity* of **75 m/s** (same for each tank shell). Based on this, answer the following,

(i) What is the recoil *velocity* of the tank when the first tank shell is fired? **(1 mark)**

(ii) What is the recoil *velocity* of the tank when the last tank shell is fired? **(1 mark)**

(iii) What is the difference in the tank's *kinetic energy* when the first tank shell is fired as compared to when the last tank shell is fired? **(3 marks)**

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**Question 2 (10 marks)**

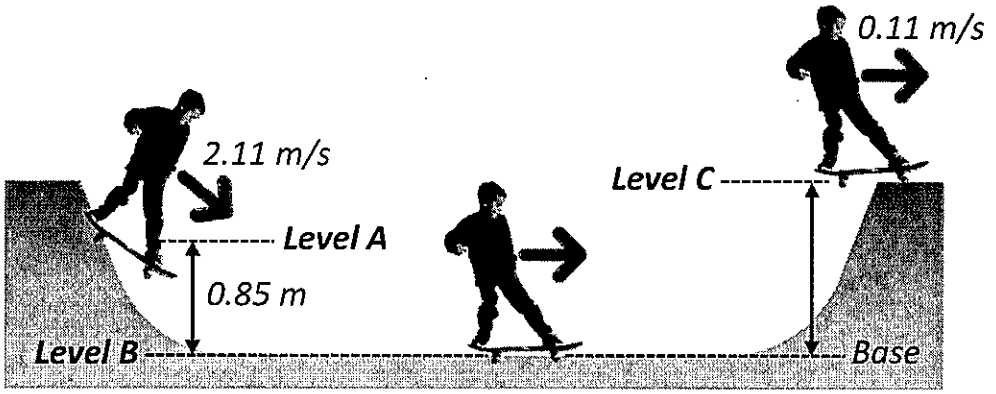


**Figure 2.1**

(a) **Figure 2.1**: A boy is skateboarding on a skating platform. At *Level A*, his skateboard is **0.85 meters** from the base and he moves with a *velocity* of **2.11 m/s**. At *Level B*, his skateboard is at the same level as the base. At *Level C*, his skateboard is at the highest level above the base. *Ignore friction* and take $g = 9.8$ m/s$^2$. Use the *conservation of energy principle* to solve this question. Based on this, answer the following:

(i) What is the boy's estimated *velocity* at the base (*Level B*)? **(2 marks)**

(ii) What is the estimated height of the highest level of the platform (*Level C*) from the base (*Level B*) if the boy has a *velocity* of **0.11 m/s** at that level? **(3 marks)**

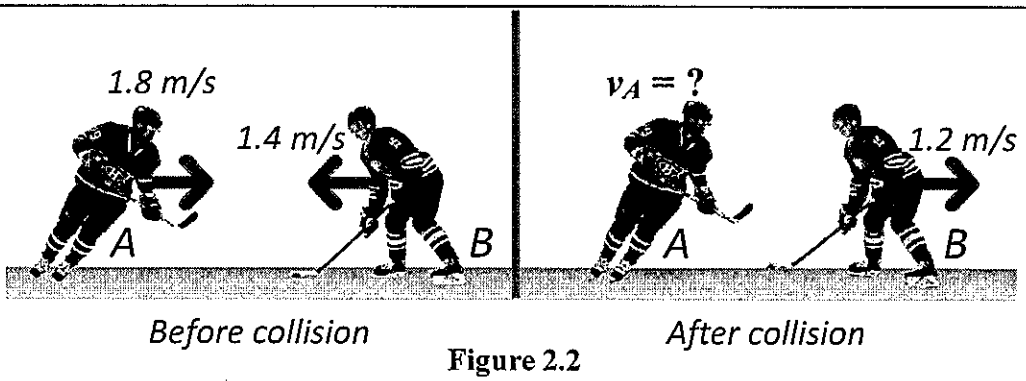


**Figure 2.2**

(b) **Figure 2.2**: Two ice-hockey players are involved in a head-on collision. Before the collision, player *A* (mass of **65 kg**) moved with a *velocity* of **1.8 m/s** while player *B* (mass of **70 kg**) moved with a velocity of **1.4 m/s** in the opposite direction. After the collison, player *B* moved in the same direction (as player *A*'s initial direction) at a *velocity* of **1.2 m/s**. Based on this, answer the following:

(i) What is player *A*'s *velocity*, $v_A$, after the collision? **(2 marks)**

(ii) What type of "collision" is this (*inelastic*, *elastic* or *explosion*) between the players? Include evidence (calculation or working steps) to support your answer. **(3 marks)**

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**Question 3 (10 marks)**

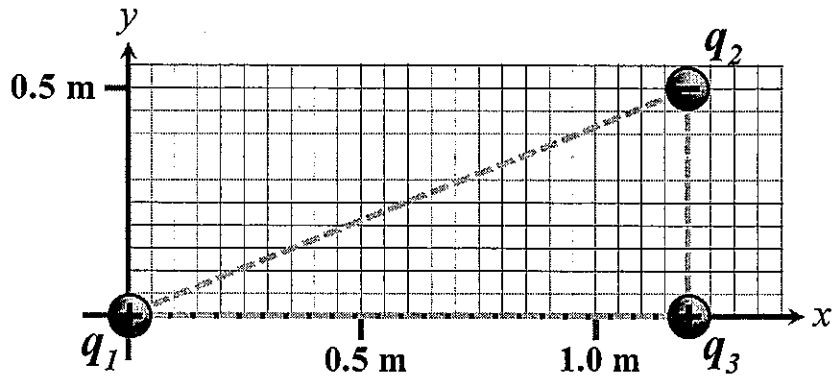


**Figure 3.1**

(a) **Figure 3.1**: A charge $q_1 = +$ **1.2 μC** is located at the origin (0,0) of an $(x,y)$ coordinate system, a second charge $q_2 = -$ **0.6 μC** is located at (1.20 m, 0.50 m) and the third charge $q_3 = +$ **0.2 μC** is located at (1.20 m, 0). (*Coulomb's constant*, $k = 9.00 \times 10^9$ Nm$^2$/C$^2$). Based on this, answer the following:

(i) What is the *net force* (magnitude and direction) on $q_2$ due to the other two charges, $q_1$ and $q_3$? **(5 marks)**

(ii) Suppose the third charge $q_3$ is replaced with $q_4 = -$ **0.2 μC** at the same position, what is the *net force* (magnitude and direction) on $q_2$ due to $q_1$ and $q_4$? **(3 marks)**

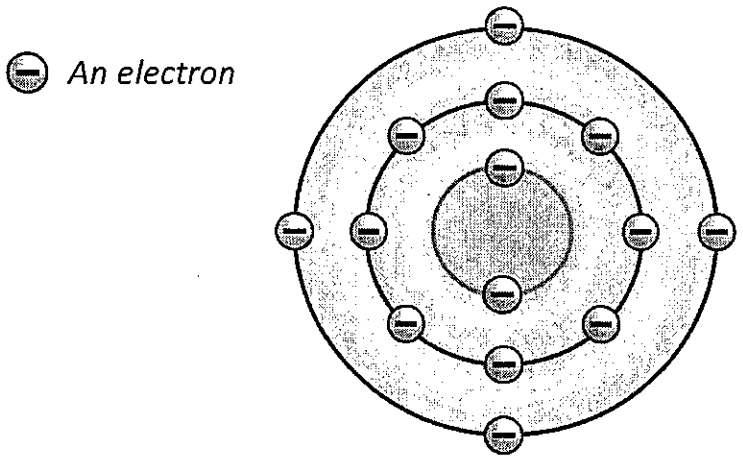


**Figure 3.2**

(b) **Figure 3.2** depicts the electron arrangement of a single *Silicon* atom. *Silicon* (14 protons in atom) and *Germanium* (32 protons in atom) are examples of semiconductor elements which are widely used in the electronics industry. Why is it *Germanium* also possess semiconductor properties like *Silicon*? What is the similarity and the difference in the electron arrangement of *Silicon*'s atom compared to *Germanium*'s atom? **(2 marks)**

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**Question 4 (10 marks)**

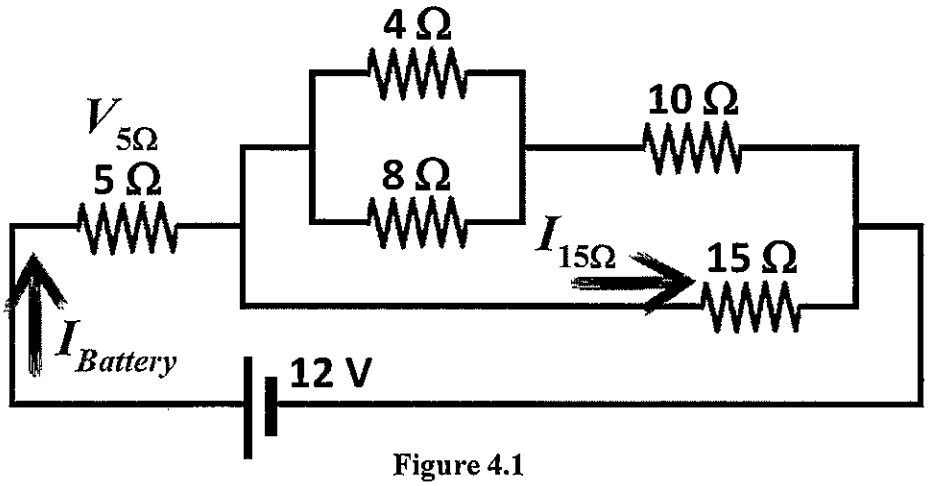


**Figure 4.1**

(a) Refer to **Figure 4.1**. The circuit above comprises five resistors with different resistances of **5 Ω**, **4 Ω**, **8 Ω**, **10 Ω** and **15 Ω** arranged in a *series-parallel* combination with a battery source of **12 V**. Based on this, answer the following:

(i) What is the *equivalent resistance* of this circuit (for <u>all</u> resistors)? **(2 marks)**

(ii) What is the *current* that flows from the battery ($I_{Battery}$)? **(1 mark)**

(iii) What is the *voltage drop* across the **5 Ω** resistor ($V_{5\Omega}$)? **(1 mark)**

(iv) What is the *current* that flows through the **15 Ω** resistor ($I_{15\Omega}$)? **(1 mark)**

(v) Which of the five resistors has the <u>lowest</u> *power* dissipated? **(2 marks)**

**Figure 4.2**

(b) **Figure 4.2**: Suppose you have exactly five resistors consisting of one **1 Ω** resistor, one **2 Ω** resistor, one **3 Ω** resistor, one **4 Ω** resistor and one **5 Ω** resistor. With a clearly <u>labeled</u> drawing of a *series-parallel* combination circuit made up of <u>any</u> combination of these resistors (e.g. use only the resistors you have, either all 5 resistors or some of these 5 resistors), show how you can create a *series-parallel* combination circuit with the *equivalent resistance* of

(i) **7.5 Ω** **(1 mark)**

(ii) **5.5 Ω** **(1 mark)**

(iii) **1.67 Ω** **(1 mark)**

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## Question 5 (10 marks)

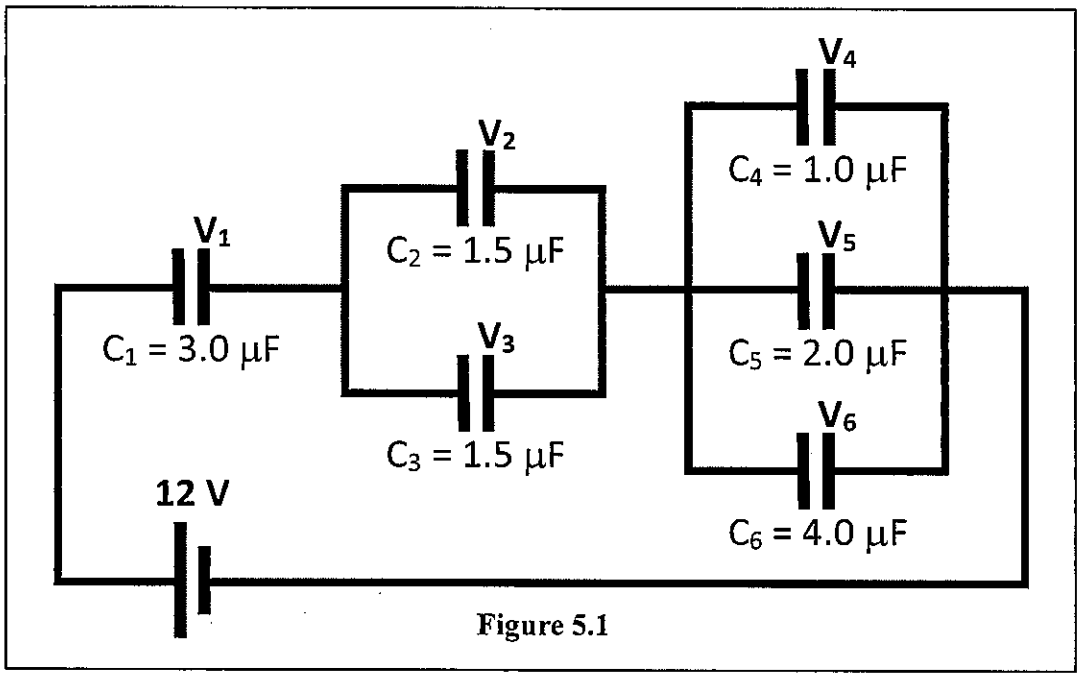


**Figure 5.1**

(a) **Figure 5.1**: A battery, the voltage of **12 V** is connected to a *series-parallel* combination network of six capacitors: one **3.0 μF** capacitor ($C_1$), two **1.5 μF** capacitors ($C_2$ and $C_3$) and three capacitors ($C_4$, $C_5$ and $C_6$) with capacitances of **1.0 μF**, **2.0 μF** and **4.0 μF** respectively. Based on this circuit, answer the following,

(i) What is the *equivalent capacitance* of the circuit (for all capacitors)? **(2 marks)**

(ii) What is the *charge* ($Q_{All}$) stored in the **3.0 μF** capacitor ($C_1$)? **(1 mark)**

(iii) What is the *voltage* ($V_3$) across the **1.5 μF** capacitor ($C_3$)? **(1 mark)**

(iv) What is the *voltage* ($V_6$) across the **4.0 μF** capacitor ($C_6$)? **(1 mark)**

(v) What is the *charge* ($Q_5$) stored in the **2.0 μF** capacitor ($C_5$)? **(1 mark)**

(vi) What is the energy stored in the **1.0 μF** capacitor ($C_4$)? **(1 mark)**

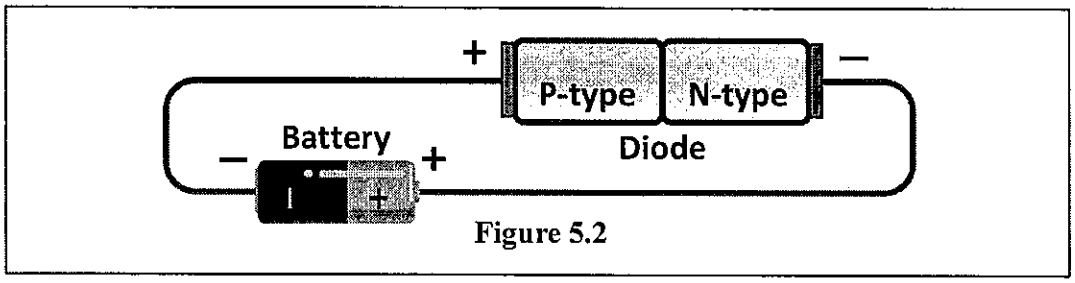


**Figure 5.2**

(b) **Figure 5.2** depicts a diode that is made up of both *p-type* and *n-type* semiconductors. This diode is connected to a battery in a circuit. Based on this, answer the following,

(i) What is the main difference between *p-type* and *n-type* semiconductor? **(2 marks)**

(ii) Is the diode connection as shown in **Figure 5.2**, *forward bias* or *reverse bias*? Provide 1 reason for your answer. **(1 mark)**

**End of Paper**

# APPENDIX

## LIST OF PHYSICAL CONSTANTS

| | | |
|---|---|---|
| *Acceleration due to gravity* | $g$ | $9.8\ \text{m/s}^2$ |
| *Electron mass* | $m_e$ | $9.11 \times 10^{-31}\ \text{kg}$ |
| *Proton mass* | $m_p$ | $1.67 \times 10^{-27}\ \text{kg}$ |
| *Elementary charge* | $e$ | $1.602 \times 10^{-19}\ \text{C}$ |
| *Coulomb constant* | $k$ | $9.0 \times 10^{9}\ \text{N m}^2.\ \text{C}^{-2}$ |
| *Permittivity of free space* | $\varepsilon_o$ | $8.85 \times 10^{-12}\ \text{C}^2\ \text{N}^{-1}.\ \text{m}^{-2}$ |

## LIST OF FORMULA

*Quadratic Formula* $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ For solving $ax^2 + bx + c = 0$

*Kinematics*

$v = v_o + at$ $\quad s = \dfrac{1}{2}(v_o + v)t$ $\quad s = v_o t + \dfrac{1}{2}at^2$

$v^2 = v_o^2 + 2as$ $\quad s = vt - \dfrac{1}{2}at^2$

*Circular Motion* Centripetal acceleration, $a_R = \dfrac{v^2}{r}$ $\quad v = \dfrac{2\pi r}{T}$

*Work & Energy* $\text{Work, } W = Fd\cos\theta$ $\quad KE = \dfrac{1}{2}mv^2$ $\quad PE_G = mgy$

*Momentum* $p = mv$

*Electricity* $F = k\dfrac{q_1 q_2}{r^2}$ $\quad C = \dfrac{\varepsilon_0 A}{d}$ $\quad \boxed{Q = CV}$ $\quad V = Ed$

$C_{eq} = C_1 + C_2 + C_3 + \ldots$ $\quad \dfrac{1}{C_{eq}} = \dfrac{1}{C_1} + \dfrac{1}{C_2} + \dfrac{1}{C_3} + \ldots$

$U = \dfrac{1}{2}QV$ $\quad U = \dfrac{1}{2}CV^2$ $\quad U = \dfrac{Q^2}{2C}$ $\quad \boxed{V = IR}$

$R_{eq} = R_1 + R_2 + R_3 + \ldots$ $\quad \dfrac{1}{R_{eq}} = \dfrac{1}{R_1} + \dfrac{1}{R_2} + \dfrac{1}{R_3} + \ldots$

$P = IV$ $\quad P = I^2R$ $\quad P = \dfrac{V^2}{R}$ $\quad R = \rho\dfrac{L}{A}$